論文R　日本物流学会誌第14号 平成18年5月

Interaction Characteristics of Delivery Vehicles and the Delivery Facility at Commercial Establishments in Urban Areas

都市内荷さばき活動における輸送機関と建物内の荷さばき施設との相互作用に関する研究

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ABSTRACT
The study investigates the important relationship between transportation vehicle (mode) and loading and unloading facility (node) at commercial establishments for delivery operation. Varieties in shape and sizes of transportation modes compounded by the various types of commercial establishments pose potential problems in goods handling. The research paper examines the extent of the interaction and evaluates the suitability of modes and nodes.

要旨
荷さばき活動には、輸送機関（モード）と建物内の荷さばき施設（ノード）がかかわる。しかし、アジア諸国でのモードとノードには多様な種類があり、場合によっては互いに適合してないこともある。これは、ロジスティクスの効率化のための一つの課題となる。そこで本研究は、荷さばき施設の計画におけるモードとノードの適合性の必要性を明らかにする。

1. INTRODUCTION

The operation of warehouses, distribution centers, and other types of logistics facilities varies and depends at a certain degree on the efficiency by which labor, space and time are managed. Time and space elements are important to goods movement. In commercial establishments which are usually located within business districts, providing space is more complicated because of relatively higher cost attributes. In logistics centers, goods move in and out based on a routine cycle of standard transportation vehicles arriving at specific loading bays with products loaded or unloaded in predetermined time and handling facility. Alteration from these standards may cause productivity losses due to incompatibility between vehicles and facilities resulting to operational inefficiencies at the logistics centers.

In urban areas, there are many commercial establishments such as department stores, supermarkets, convenience stores and other retail stores with each having their separate business practices, different goods receiving schemes and goods handling. Commercial establishments lack the luxury of space compared to logistics centers such that space is utilized and dedicated more on product display rather than on product storage. Short term stocks are then limited to facility capacity, a forecasted requirement, or minimum replenishment delivery volume. Generally the product replenishment is more dependent on deliveries from suppliers than from its own storage. Due to the diversity of products in commercial establishments, replenishment is done by many suppliers and therefore deliveries from a variety of transportation modes of different shapes and sizes are expected.

2. SIGNIFICANCE OF THE STUDY

New transportation policies, business practices, and vehicle operation costs lead to changes in transportation systems and services for goods delivery. These changes have affected how business operates including how commercial establishments operate its delivery facility. These facilities include the waiting area for trucks, unloading area, inspection area, backroom storage, and passage ways. Characterizing the changes that have occurred can help transportation planners, logisticians and architects to design a more effective delivery facility for goods movement in the urban environment.

The relationship between the mode and node is important to determine a cost effective design criteria for delivery facilities. Examining their suitability and incompatibility also provides information on its interaction characteristics which will resolve how delivery facilities will be designed to meet current and future needs. An understanding of how these logistics infrastructures interact leads to better formulation of guidelines for unloading and loading facilities for commercial establishments.

3. OBJECTIVE

It is a fact that suitability and optimum solutions change over time. This research paper is intended to determine the changes that have occurred to the transportation mode and its load. Also it aims to address issues in the suitability of delivery vehicle *and delivery facility of commercial establishments.*

This research will make clear how deliveries are made at commercial establishments in cities by taking into consideration the population profile of transportation modes. This will also provide basic knowledge in understanding how multi-modes affect the delivery facility of commercial establishments. New policies might come handy to affect a new set of planning guidelines for effective loading bays of commercial establishment in business districts.

Suitability between mode and node is a measure of appropriateness. Basically, it can be called suitable if goods can be unloaded from a vehicle to the receiving area of a commercial establishment. However, it is difficult to determine if mode is unsuitable with nodes and vice versa because incompatibility only exists if goods cannot be unloaded. Goods will still be unloaded on a number of methods with varying efficiencies. With the understanding of the characteristics of the interaction between mode and node this can be made clearer.

4. METHODOLOGY

To attain the objective of this research the first step is to identify the changes that occurred in vehicles registration. Then, an investigation on how this affected the operation of commercial establishments would confirm that changes had occurred. An assessment on how goods are loaded and unloaded from vehicles at delivery points would provide us a glimpse how to deal with current and future delivery practices.

5. RESEARCH CONCEPT

5.1. OVERALL CONCEPT

Simplification of a delivery activity is an explanation *of how mode and its cargo interact with the node* itself. Modes are viewed as means for movement, nodes destinations, and in between are delivery constraints. To obtain an effective goods movement in commercial building or establishment, two things need to be present as shown in *Figure 1.* First, there must be an effective delivery method such that there

must an effective delivery method for deliveries to the node. Vehicles must be able to load and unload goods at its destination and also incorporate activities with its transit.

Second, the nodes must be efficient in utilizing delivery facility by time reduction in unloading, inspection, and storage or display activities. Reducing waiting of vehicles at its destination is a result of efficient nodes and is great benefit for the recent frequent delivery phenomena. Consequently, efficiencies in loading and deliveries contribute to the alleviation of traffic congestion at commercial establishments and its surrounding areas.

Figure 1 : Components for an Effective Goods Delivery

The choices for delivery method are indirect and direct. Indirect methods are via cooperative delivery, logistics center, and cross-docking. Direct methods are deliveries made from suppliers to customers by a single delivery vehicle only. From these choices there exists an effective delivery method for particular commercial establishments on particular commercial goods. Further, these methods are important and can be integrated in the activities in the delivery facility, such as during unloading, inspection, and storing activities.

To have an effective delivery, it must be made at the least possible period time from departure from supplier to storage at commercial establishments. Integrating activities in the delivery facility to the delivery methods is one possible area of time savings. These time savings are important to truck operation such that more trips are possible on a daily basis. Likewise, it would benefit time sensitive products like fresh products and produce for there will be less time in transit.

5.2. VEHICLES AND FACILITY CONCEPT

For this research, commercial establishments are divided into five general classifications, namely: commercial center, public market, supermarket, convenience store, small (sari-sari) store. These classifications are based on their size. Although the classification boundary between these groups is vague, it can also be classified according to actual categorical names. In Japan, the classifications are made based on the actual number of items available in the commercial establishment.

Based on the unique transportation services offered by each transportation modes and the different demands levels of commercial establishments, *Table 1* shows an assumption of how the relationship of modes and nodes be supposed to occur. The relationship is an inbound deliveries made to commercial establishments.

Table 1 : Logical relationship of transportation mode and commercial establishment

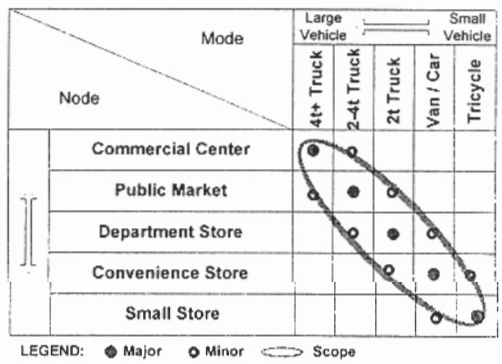
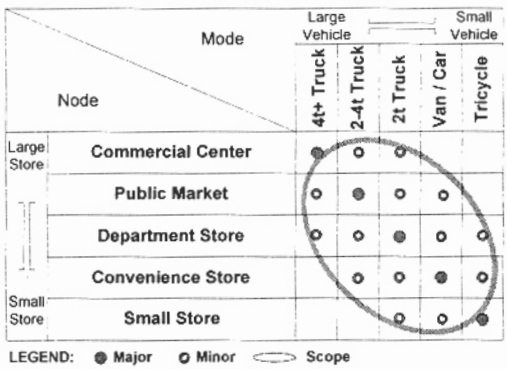


Table 1 indicates the typical modes used to a set group of nodes. Large vehicles cater to large stores and small vehicles cater to small stores. Large trucks such as 2 to 4-ton truck service primarily public

markets but also commercial centers, and department stores. Some vehicles are not appropriate (without any marks) to some establishments because of practical reasons. In the Philippines, tricycles transportation service caters to small stores because small number of goods is delivered. The scope of relationship is indicated in the table that reflects how the relationship is mapped. *Table 1* also highlights some basic relationship on loading and unloading methods that are provided for each type of node such as loading bays with elevated platform for large trucks.

Recent scenarios show that most transportation mode is made to suit a greater number of commercial types as illustrated in *Table 2*. Relatively smaller vehicles are being used to larger commercial establishments and larger vehicles are used to relatively smaller stores. The area of the scope is much larger in this table.

Table 2 : Emerging relationship of modes and nodes



Trucks provide suitable cargo hold for any size and weight, including some variations in temperature environment. But despite the simplicity and durability of delivery trucks, many other transportation modes are often used in the delivery of goods to commercial establishments. Vans have become popular these days due to the rigidity of trucks in coping with changing delivery service types and trade practices.

With such broader relationship, delivery facilities are made to cater to a larger number of vehicle types. In terms of facility planning, general design criteria is becoming non-vehicle specific. This poses questions on how loading bays are designed and that it should not only have elevated platform for large trucks but also ground-level platforms as well. Large vehicles can also be made with built-in lift system to be made suitable to no-platform delivery facility. The hybrid design for both mode and nodes are formulated for such operational delivery system to exist. These radical changes can solve suitability issues but at the point of view of overall efficiency that the variety of vehicles to a particular facility should be limited as illustrated in *Table 1* to reduce cost in design. Reversing the situation requires a deeper understanding on the current delivery practices in commercial establishments.

To further illustrate the changing vehicle type, despite the sophistication in the delivery services and vehicles, parking provision policies remained the same. Policy for parking space in commercial establishments remained static. Space size and number remained fixed despite possible changes in the dynamic attributes of space. In Philippines, parking provision remained to one loading bay for every 5,000sq.m. of commercial space. Loading, and unloading space could be used more efficiently if tools, techniques and support facilities could be provided in improving its overall performance through a new policy measures.

6. SURVEY DATA

There are at least four main trends that affect goods transportation. This is probably due to factors such as

growing traffic congestion and business competition in cities. First would be the trend in vehicle registration particularly in the growing registration of small vehicles. Second is the dwindling load factor for goods deliveries. Third is the policy that restrict deliveries to cope with traffic congestion, and last would be the growing trend on outsourcing trucking operations (from many business operation.)

In the Philippines utility vehicles (2-tons and less) have been continually growing at the rate of 11% per year compared with the negative growth for trucks (4-tons or more) at -3% and articulated trucks at -2% annually (DOTC, 2003). The growth can also be related to *truck ban* transport policy that prohibits large trucks during peak hour (Tiglao, 2005).

Aside from the trends in vehicle registration, goods vehicle trip demand remained high in Japan. In Tokyo CBD, it is estimated that there is about 14,000 goods vehicle trip for every square kilometer. This is about 2.6 times compared with Manhattan, New York. Further, the load factor in Japan for small trucks dropped significantly from 34% in 1970 to only 18% in 1990 (Kuse, 1999). These trends showed that there will be more small trucks delivering fewer goods and at the same time will be having more trips relatively. This condition suggests that modes and nodes will interact more frequently but lesser number of goods per transaction. This is where compatibility or suitability of mode and nodes becomes an issue. It is evident that in a delivery facility in one of the prominent retail store in the Manila (Philippines), *Figure 1* and *2*, a variety of delivery vehicles and methods are occurring. The facility is designed for large trucks but a two-third of it are being used by smaller vehicles that include vans and cars. It is also noted from the picture that the unloading platform designed for larger trucks are used by smaller vehicles .

Figure 2: Delivery facility with mixed types of delivery vehicles

Figure 3: Unloading activity in a delivery facility with mixed types of delivery vehicles

In the Philippines, the most popular transportation mode for rural goods transportation is the *Jeepney*. The versatility of this vehicle made it practical for Filipinos for passenger and transportation of agricultural products. More so, the Philippine's tricycle, a three wheeled vehicle improvised from a motorcycle, growing in number at the rate of 13% annually are used to transport people and goods.

The diversity of transportation vehicles for goods delivery appeared because it provides unique transportation service that is convenient and beneficial to its users. Its proliferation is likewise catalyzed by the availability and applicability of local knowledge and local building materials. Another characteristic of these modes is also differentiated by loading and unloading time. Trucks are efficient in loading and unloading of large quantities if support facilities like pallets, rollboxes,

ramps, and forklift among others are present. However, for manual loading and unloading, simplicity in accessing goods and handling make jeepneys or tricycles more convenient for small quantities.

A great deal of information is available in Oshima (2003) research in dealing with the provision of space for parking in Japan, particularly on 1) variety of delivery trucks, 2) parking duration for delivery and pick-ups 3) type of loading, 4) goods handling methods 5) commodities volume, and 6) commodity sizes. Another research by Sinarimbo (2005) dealt with freight transport management in the CBD and found that cooperative delivery systems could reduce congestion at CBD, and among other things.

6.1 Variety of Delivery Trucks. The main transportation modes used in Japan are 2-ton truck and trucks under 2 tons, then vans, and wagon. Based on Oshima (2003), 32% of all deliveries are made by 2-ton trucks, 14% by less than 2-ton, 18% by Van, 19% by Wagon 5.8% by Cars. Note that deliveries are made by a variety of transportation modes. In the case of Metro Manila, only about 4% are delivery made by large trucks and 96% are made by small trucks and other modes, as illustrated in Fig.1.

Table 3: Variety of delivery trucks

Vehicle Type	Philippines (% share)	Japan (% share)
4t & above truck	4%	0.5
4t truck	96%	7.1
2t truck		32.4
2t & under truck		14.0
Van		18.6
Wagon		19.3
Car		5.8
Others		2.3
Total	100	100

6.2 Parking and Duration. *Table 4* shows that the parking duration in Japan for deliveries and pickups are mostly made within 10 minutes. It also shows that as parking time increases, the volume of vehicles decreases. There exists a simple direct relationship between vehicle count and period of parking. In the case of Philippines, unloading duration is more distributed in the range. It is difficult to compare with the Japan scenario because of the difference in context.

Table 4: Parking duration for delivery and pickups

Parking Time Minutes	Philippines* (% share)	Japan (% share)
0-10	18.4	44.4
10-20	25.2	23.4
20-30	22.2	16.8
30-40	18.4	8.0
40-50	11.3	3.3
50 & above	4.5	5.1
Total	100.0	100.0

* - unloading only

6.3 Type of Loading and Type of Goods. *Table 5* shows that about 80% of all goods movement are deliveries to large retail complexes. It conferred with the purpose of commercial establishments such that products are taken out by costumers or consumed in the establishment. With *Table 4*, goods can be visualized functioning primarily as unloading bays.

Table 5: Type of Loading, Japan

Type of Loading	Count, Vehicles	Share, %
Pick-up	15	7.4
Delivery	164	81.2
Pick-up & Delivery	23	11.4
Total	202	100

Oshima, 2003

For the packaging of goods in Manila, it shows that most of the goods are packed in boxes or bags as shown in *Table 6*. The type of goods can be further subdivided by tolerance, or specifically, temperature. From Oshima (2004), about 84% of deliveries are in

the normal range temperature and 9% are required to be cooled and about 4% needs are frozen, while the rest have no required tolerance. Thus, assortment of goods with varying sizes, packaging and tolerance are delivered to commercial establishments.

Table 6: Type of Goods, Manila

Type of goods	Share, %
Appliances	10
Perishable Goods	13
Trays and Crates	29
Boxes and Bags	48

Sinarimbo, 2005

6.4 Goods Handling Methods. *Table 7* shows the method used in the unloading of goods from truck to final destination in the establishment. The most used goods handling method is by hand (41.3%) and by trolleys (52.8%). Two things can be said from these data. First, goods which are handled in the commercial complexes are light enough to be carried by hand or trolleys and that there is no need for special equipment. Second, only two methods are mostly used. This would indicate that combined with *Table 4*, despite the variety of vehicle types used (about four) only two methods for handling are often used.

Table 7: Method of Handling Goods

Method	Count, Vehicles	Share, %
By Hand	132	41.3
By Trolley	169	52.8
Forklift	5	1.6
Pallet	14	4.4
Rollbox	0	0
Total	320	100

Oshima, 2003

Further, in the Philippines, retailers are faced with all the variety of packaging types in all forms and sizes due to the number suppliers. Varieties of pallets, crates, boxes, and cases are found on a typical day in the receiving area, *Figure 4*. About 96% of commodities are unloaded by hand from small trucks. The rest are unloaded using pallet jacks from large trucks.

Figure 4: Typical packaging of goods and handling, Manila Philippines

On *Table 8*, for the number of commodities handled in the loading and unloading facility, there is no particular pattern in the number of commodities delivered but it should be noted that about a third of all the transactions are one piece commodity.

Table 8: Number of Commodities

Number of Commodities	Count, Vehicles	Share, %
1-2	109	33.6
3-4	69	21.3
5-6	45	13.9
7-8	28	8.6
9-10	21	6.5
11 and Above	52	16.0
Total	324	100

Oshima, 2003

On *Table 9*, most of the goods are packed in medium-sized container at 67.7% followed by small-sized packs with 26.4%. This data also confirms the result of *Table 7* which indicated the method used in handling the goods. In continuation with the adoption of a common base unit measurement for goods, interestingly, for all transportation modes

only about a quarter of it delivers a piece of commodity. *Table 9* shows a typical variety of commodity sizes. However, the table does not indicate the absolute sizes of the commodity but only indicates the relative sharing of sizes.

Table 9: Commodity Size

Commodities Size	Count, Vehicles	Share, %
Large & Above	11	3.3
Large	18	4.7
Medium	206	65.7
Small	81	26.4
Total	316	100

Oshima, 2003

7. Analysis

Based on the data gathered, the following information is revealed, to wit: 1) A variety of transportation modes unload goods in commercial establishments with vehicle types predominantly vehicle with less than 2-ton capacity, 2) Increasing population of small trucks, van and other Asian built-up vehicles compared to large delivery vehicle, 3) Parking duration in commercial complexes for delivering of goods is relatively short and is relatively predictable. Although in the case of the Philippines, unloading duration is relatively distributed within 50 minutes, 4) Commercial establishments are primary destination of consumer products, such that most of the transaction handled are incoming deliveries, and 5) Almost all of the deliveries are unloaded by hand or trolleys.

8. Conclusion

The relationship of transportation mode and delivery facility of commercial establishments plays an important role in the overall movement of goods in urban areas. However, greater importance should be considered in the role of transportation modes. It is evident that transportation vehicles influence how goods are loaded and unloaded due to vehicle characteristics. This suggests that nodes must accommodate the variation of vehicles at all times. Infrastructures need to address the growing variety of vehicles to fulfill each delivery activity.

9. Recommendation

This study recommends that planners should look back at the design criteria for delivery facilities in commercial establishments such that it should be redesigned to accommodate all vehicles types because elevated platforms that are suitable for trucks might not be suitable for other modes. It is recommended to eliminate mode-specific facility to make it more practical. Alternatively, the variety of vehicle could be reduced to limited types so that less modification are made to delivery facility and vehicles. This can be done via cooperative delivery, cross-docking, and other alternative methods.

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